FEASIBILITY STUDY OF A 3-DIMENSIONAL DOSIMETRY PHANTOM FOR LEKSELL GAMMA KNIFE PERFEXION

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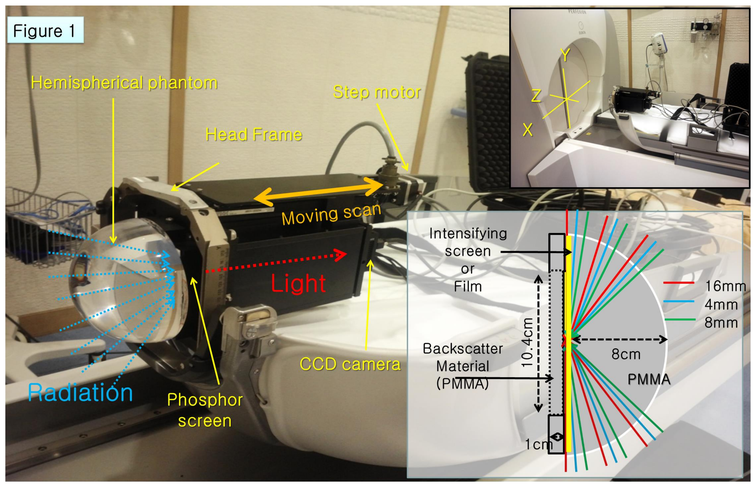
Purpose

- **TheThe purpose of our study is to develop a method of verifying the 3-D dosimetric configuration of the collimated sources using a phosphor screen with a CCD camera in the Leksell Gamma Knife-Perfexion(LGKP).**

Material and Methods

- **The instrument consists of a moving head phantom, an embedded thin active layer and a CCD camera system and was designed to be mounted to LGKP.**
- **The system consists of a intensifying screen (Gd2O2S:Tb, 10cm×10cm, Fujifilm Corp, Japan), CCD camera (VA-2MG-42, 1200×1200 pixels, Syncron Corp, Korea), Lens, Hemispherical phantom (HP) (diameter 16cm, PMMA material), system controller board, step motor to moving the system and control PC.**
- **The system based on CCD camera can be measurements of 2D light output with a large dynamic range. The center of HP was mounted at the isocenter with its axis aligned along the longitudinal(Z)-axis of the couch. the backscatter plate (BP) was placed the inside of HP for the additional backscatter compensating.**
- **The intensifying screen was placed between the HP and backscatter plate (BP). The scan image was obtained each collimator size, and the exposure time was 0.5s to all positions.**
- **Using the system, 300 images with 0.2 mm slice gap were acquired under three collimator setups (4mm, 8mm and 16mm), respectively.**
- **The 2D projected doses from the 3D distributions of the CCD doses were compared with the irradiated film dose.**

Figure 1

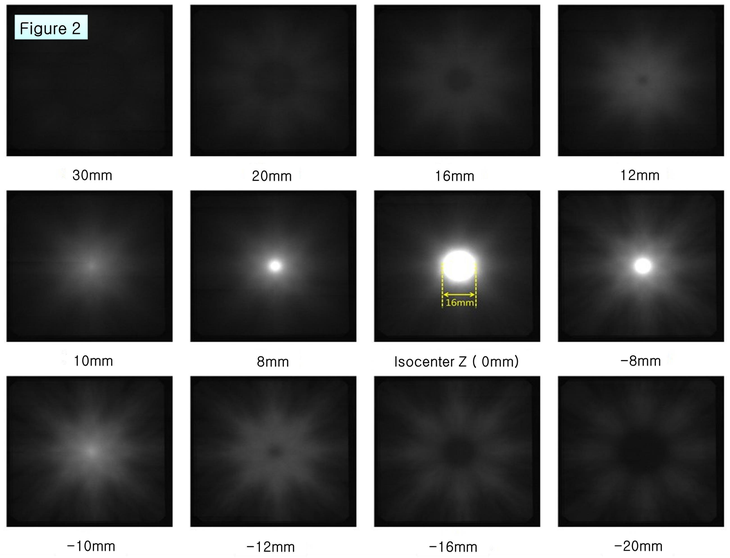


- the 2D projected images from the 3D distributions of the CCD images were compared with the irradiated film dosimetry.

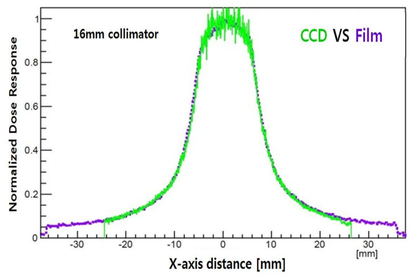
Results

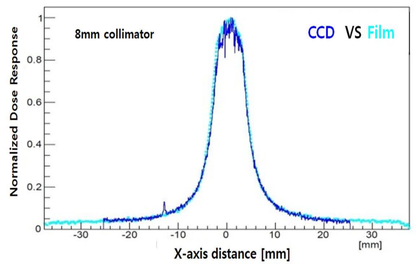
- **As all doses normalized by the maximum dose value in 16 mm setup, the relative differences between the equipment dose and film dose were 0.2% for 4mm collimator and 0.5% for 8mm.**
- **The acquisition of 300 images by the equipment took less than 3 minutes.**

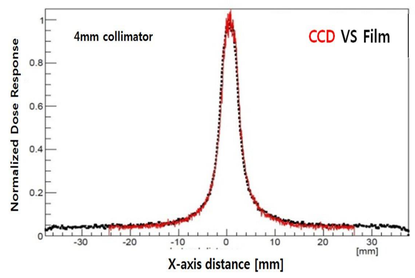
Figure 2



- The CCD images of 16mm collimator was shown in the Fig 2. We confirmed the beam pass of the 192 source irradiation in the 8 sector. The window level of CCD images was adjusted in order to better distinguish. The highest image density was indicated to the isocenter position (Z : 0mm).

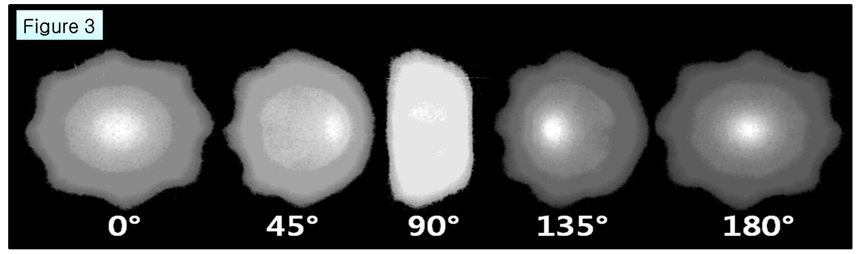






- The dose profile curves comparison of normalized film and CCD dose response with 4mm, 8mm and 16mm collimator.
- The thin line (green, blue, red) shows the profile of the CCD system. The dotted line shows the profile of the film.

Figure 3



- As shown in the Fig 3, the scan images of 16mm collimator was reconstructed 3D images using the ImageJ program.

Figure 4

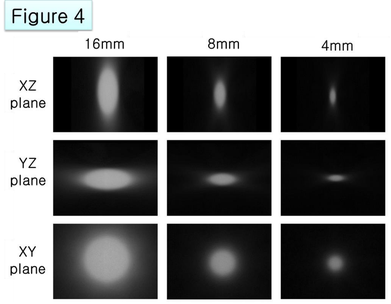
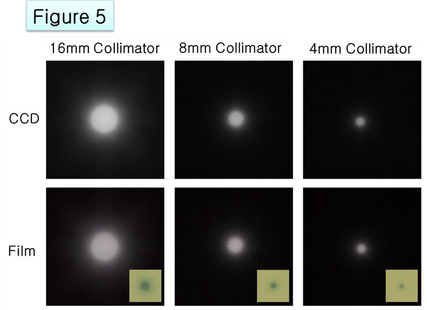


Figure 5



- Fig 4, dose distributions for each collimator was shown in each cart esian plane (XY, YZ, XZ) using the 3D projection images with bright est point.
- Fig 5, Comparison between scan images and film measurement ima ges; The measured film was scanned using a Epson scanner. it was converted dose images using the FilmQA pro 2012 program.

Conclusion

- **The new equipment was verified to be a good substitute to radiochromic film, with which required more time and resources.**
- **Especially, the new methods was considered to provide much convenient and faster solution in the 3D dose acquisition for LGKP.**